Sustainable integrated management of the Greater Snow Goose in Québec

2005-2010 Action Plan

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Sustainable Integrated Management of the Greater Snow Goose in Québec

2005-2010 Action Plan

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Published by Authority of the Minister of the Environment
© Her Majesty the Queen in Right of Canada, 2006
Catalogue No.: CW 66-262 12006
ISBN.: 0-662-49158-0
Legal Deposit National Library of Canada, 2006

This publication should be cited as:
Bélanger, L. and J. Lefebvre 2006. Plan for Sustainable Integrated Management of the Greater Snow Goose in Québec: 2005-2010 Action Plan. Canadian Wildlife Service, Québec Region, Environment Canada, Sainte-Foy, 34 p.

Photos Credits:
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FOREWORD

In preparation for this new Action Plan, a number of consultations were held. First, in April 2004, the Canadian Wildlife Service organised an orientation workshop on the management of the Greater Snow Goose in Québec with the stakeholders and partners of the Committee for the Integrated Management of Greater Snow Geese in Québec (see below). In September 2005, a preliminary version of the plan was presented for discussion to the committee members at their annual meeting. A broader consultation extending over many consecutive weeks in fall 2005 and winter 2006 was also held with other organisations (Hunting, Fishing and Trapping Coordinating Committee, Migratory Bird Management Round Table.).

The objective of these consultations was to reach the broadest possible consensus on the development of the present Action Plan and to have all partners adopt a common view on the issue of the Greater Snow Goose. Central to this common view are two facts: the need to maintain a healthy continental population so that the geese may be able to recover in case of a natural or man-induced disaster (epidemic, oil spill, etc.) and the need to avoid threatening the ecological integrity of its natural habitats and related biodiversity. This would allow to minimise the negative impacts on farmlands while maximising the local communities' economic spin-offs generated by the geese.

The Canadian Wildlife Service would like to thank all the representatives of the member organisations of the Committee for the Integrated Management of Greater Snow Geese in Québec for their valuable comments and suggestions: Agriculture and Agri-Food Canada, the Assembly of First Nations, the Association québécoise des groupes d'ornithologues, Ducks Unlimited Canada, the Conseil pour le développement de l'agriculture du Québec, the Fédération des pourvoiries du Québec, the Fédération québécoise de la faune, the Financière agricole du Québec, the Fondation de la faune du Québec, the ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec, the County Regional Municipality of Montmagny, the ministère des Ressources naturelles et de la Faune du Québec, the Union des producteurs agricoles, the Union québécoise pour la conservation de la nature, and the Université du Québec à Montréal and Université Laval. Many Canadian Wildlife Service staff members also took part in the many phases of writing and reviewing this document under the supervision of Luc Bélanger, science manager of the Migratory Birds Division, and Josée Lefebvre, Arctic goose biologist. We also owe special thanks to Pierre Brousseau, Katia Chevalier, Kathy Dickson, Chantal Lepire, Yvon Mercier, Paul Milot, Éric Reed, Daniel Robitaille, Jean Rodrigue, Francine Rousseau, Raymond Sarrazin and Stéphane Turgeon.

The implementation of this plan in the upcoming years represents a real challenge. Its success depends on many factors, including the participation of all partners and stakeholders within the scope of their mandates, areas of expertise and fields of interest, and their access to the necessary funding to proceed with the implementation of the different targeted actions. The Canadian Wildlife Service invites all stakeholders to actively take part in the implementation of this plan and to send their comments and suggestions to ensure the sustainable development of this important resource that is the Greater Snow Goose in Québec.

The Greater Snow Goose is an international resource whose management is very complex due to its cross-border migrations, which involves a large number of stakeholders and jurisdictions (Figure 1). Factors adding to this complexity are the influence of annual weather conditions on the population and habitat dynamics (breeding success, hunting harvest, natural habitat vegetation productivity, etc.) and the high adaptation capacity of the geese that must cope with changes in hunting and protected area regulations, changes in farming practices, hunting regulations, etc.

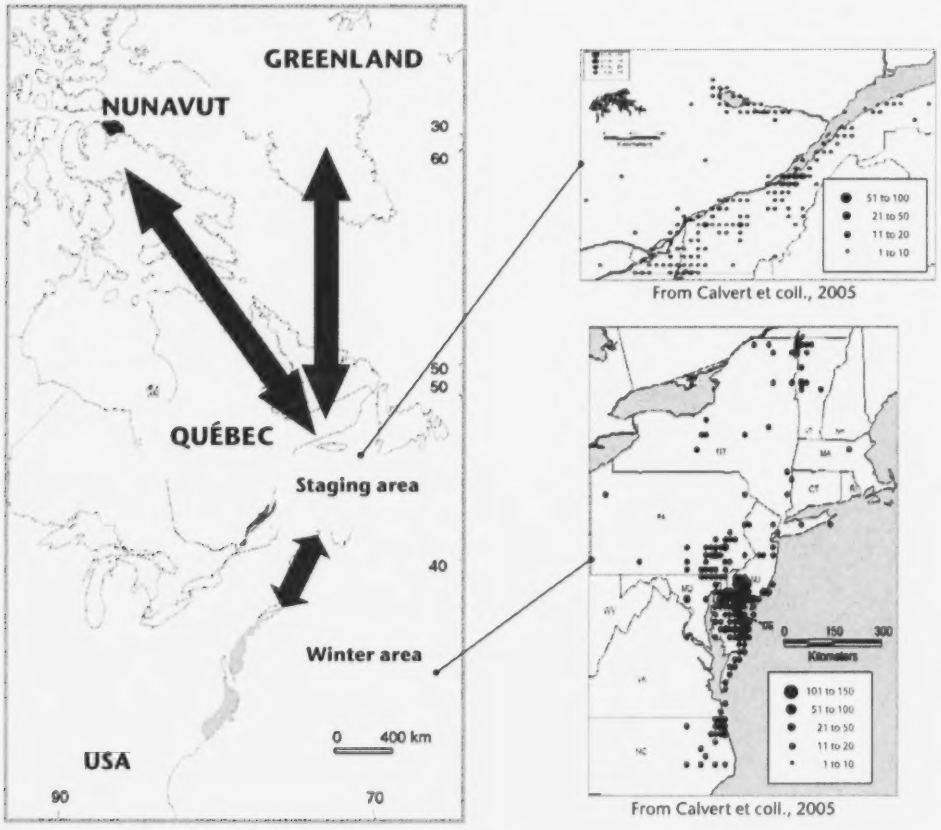

Figure 1: Distribution of the Greater Snow Goose in North America.

In Québec, the Greater Snow Goose has been subject to rigourous management based on the best available scientific and technical data as well as on the combined efforts of the largest possible number of stakeholders. It is with this purpose in mind that the Committee for the Integrated Management of Greater Snow Geese in Québec was created in 1996. Over twenty representatives from the main government and non-government agencies are involved in the many aspects of the goose population management, including: Agriculture and Agri-Food Canada, the Association québécoise des groupes d'ornithologues, Ducks Unlimited Canada, the Conseil pour le développement de l'agriculture du Québec, Environment Canada (Canadian Wildlife Service), the Fédération des pourvoiries du Québec, the Fédération québécoise de la faune, the Financière agricole du Québec, the Fondation de la faune du Québec, the ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec, the ministère des Ressources naturelles et de la Faune du Québec, the Union des producteurs agricoles, the Union québécoise pour la conservation de la nature, the Université du Québec à Montréal and Université Laval. Other organisations occasionally take part in the workshops and working groups organised according to the different aspects of the Greater Snow Goose population management in Québec.

In the early 1980s, the Canadian Wildlife Service and the U.S. Fish and Wildlife Service published a management plan for this population. At that time, the total Greater Snow Goose population was estimated at approximately 250,000 individuals (Figure 2). Of course, many changes have occurred since then, and a dramatic population explosion was observed. To a large extent, this growth is attributable to the increasing use by the geese of farmland as feeding grounds, in both staging and wintering areas. In 1998, when the size of the continental population exceeded 800,000 individuals, the first scientific assessment of the situation of the Greater Snow Goose over its entire range across the continent was undertaken (Batt, 1998). Prepared by a group of American and Canadian scientists as part of the Arctic Goose Joint Venture (a component of the North American Waterfowl Management Plan), the assessment concluded that there was the overabundance of the species and examined the possible consequences on its natural habitats.

The report's main considerations and recommendations can be summarised as follows:

- The Greater Snow Goose's annual growth rate of 9% must be stopped as soon as possible because this rate means the population will double every 8 years. The most efficient management measures must be based on the reduction of the survival rate of adult individuals;

- The long-term integrity of the Arctic ecosystem used by the Greater Snow Goose could be threatened by its intensive use by the geese. For many years, the exponential population growth has caused a localised degradation of the spartina marshes of the U.S. Atlantic coast and a decreased productivity of over 60% of the bulrush marshes of the St. Lawrence upper estuary. In addition, the population's sustained growth causes increased agricultural losses in Québec and requires many hundreds of thousands of dollars annually in order to assess the losses and compensate the affected people;

- The reduction levels should be adjusted to the carrying capacity of the natural habitat, which shall be determined throughout the stabilisation phase. In regards to the carrying capacity of farmlands, an arbitration is necessary to establish a satisfactory target population from th biological, ecological and economic perspectives.

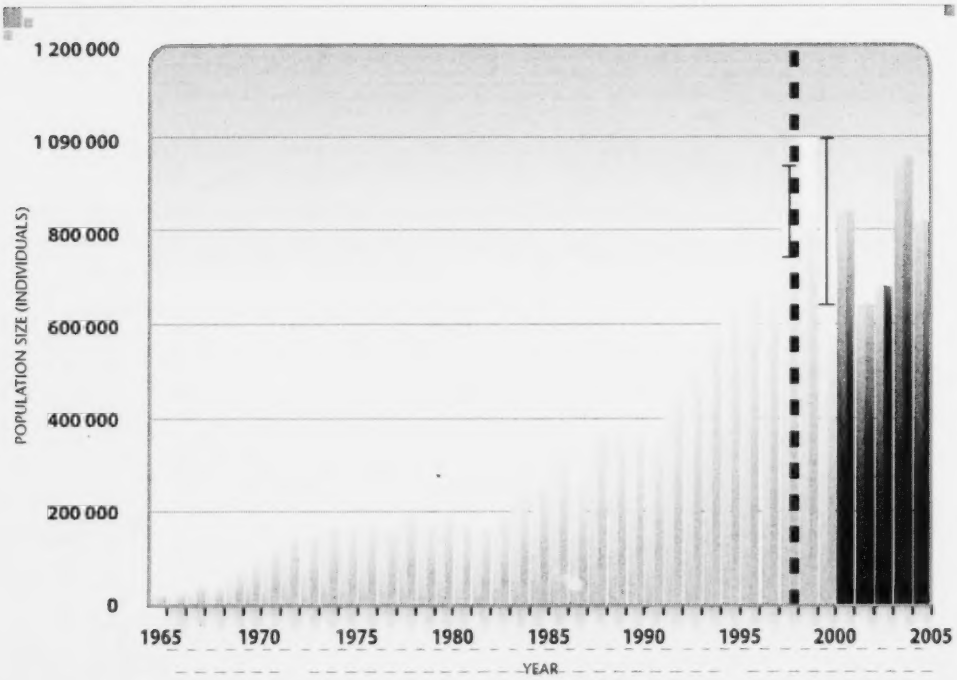

Figure 2 : Estimated population size of the Greater Snow Goose according to the Canadian Wildlife Service spring surveys (1965-2005).

Note: Changes in the above bar colour indicate modifications in the methodology used. From 1998 to 2000, the lighter part of the bars indicates a correction made following a radio telemetry study. The dotted line indicates the beginning of the application of special conservation measures.

In response to this scientific assessment and considering the recommendations made by the group of experts, the Canadian Wildlife Service developed its first action plan (1997-2002) following a number of consultations conducted with the main public and private stakeholders and interest groups in Québec (Committee for the Integrated Management of Greater Snow Geese in Québec). The objective established then was to prevent environmental damages and reduce farmland degradation while maintaining the economic benefits associated with the migration of the Greater Snow Geese through Québec and improving the long-term management of this important international resource.

Many actions were taken with regard to hunting regulations, habitat management, damage to farmland and wildlife watching. In order to assess the results of these actions, the Canadian Wildlife Service has been participating since 2003 in the production of a second scientific assessment, again with different Canadian and American experts under the Arctic Goose Joint Venture. This second assessment is aimed at assessing the results of the special conservation measures implemented since 1998, in particular, a spring conservation harvest, which is the first one in North America since 1916. It takes into consideration all new scientific and technical information on the Greater Snow Goose. Based on past results and on the various scenarios of population trends over the upcoming years, the Canadian Wildlife Service has committed to propose a new action plan.

This 2005-2010 Action Plan on the Integrated Management of the Greater Snow Goose is divided into three different sections. The first section is a summary of the recent scientific assessment of the special conservation measures. The second section presents more recently acquired information and considerations, that is from 2003 to 2005. Finally, the objectives, strategies, orientations and actions proposed for the coming years are presented in detail in the third section.

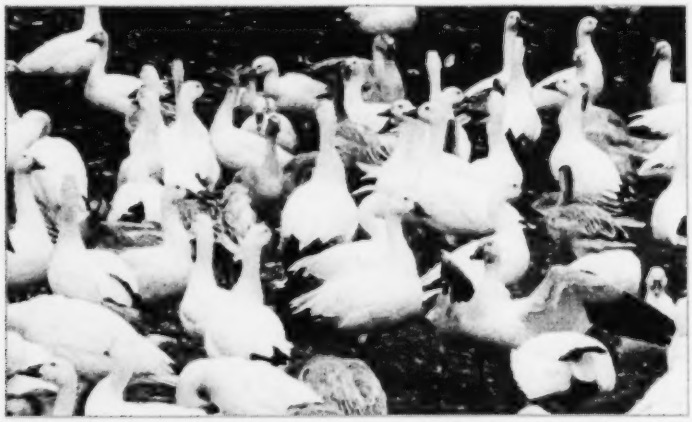

Photo : André Lanouette

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Photo : André Lanouette

The implementation by the different partners of the measures proposed in the 1997-2002 Action Plan on the Integrated management of the Greater Snow Goose in Québec has allowed us to achieve the intended objectives as most of the actions that had been identified were carried out. Table 1 presents the different planned activities in the 1997-2002 Action Plan. As we can see, most of the actions, notably those relating to scientific monitoring, hunting regulations and farmland depredation have been implemented.

Special Management Measures (Regulations)

The second scientific assessment of the special conservation measures prepared under the Arctic Goose Joint Venture (Reed and Calvert, in progress) indicates that the main outcome of the recommendations formulated in 1998 was the implementation of a spring harvest in Québec; it is an exceptional measure in North America since the signing of the Migratory Bird Convention Act in 1916. Furthermore, hunting regulations were liberalised to increase the fall harvest in Québec and the winter harvest in the United States, i.e. during the usual regulatory sport hunting period of 107 days.

A review of survey data indicates that these management measures, implemented between 1999 and 2003, have reduced population growth and stabilised its size between 800,000 and 1,000,000 individuals, as recommended by the group of experts. The result of the 2005 spring survey, 814,600 geese, confirms this trend (Figure 2). Now, among all the special conservation measures implemented, recent analysis shows that the spring conservation harvest and, to a lesser extent, the liberalised winter hunting regulations in the United States have been the most efficient measures in reducing the population growth rate. This can be explained by their direct and indirect impact on breeding adults.

The halt in population growth has been attributed to an increase in the number of adult geese killed by hunting as the mean harvest rate went from 6% before 1998 to 12% afterwards. One of the causes would be the spring conservation harvest in Québec which, over the past 7 years, amounted to between 22,000 and 71,000 individuals killed per year. Another indirect effect to be noted is a decrease in the physical condition (body fat) of adults resulting in a lower reproductive success. This effect is the result of increased disturbance in springtime (presence of hunters and scaring devices), of reduced feeding time and fattening conditions due to a reduced access to farmlands.

Table 1: Summary of the actions identified in the 1997-2002 Action Plan on the Integrated Management of the Greater Snow Goose in Québec.

ACTION PLAN COMPONENTS	PLANNED ACTIVITIES	STATUS
Regulations (special management measures)	Develop the management/spring harvest program, especially the implementation of a spring conservation harvest on farmlands, with the exception of two territories where bird watching activities are important, the F district (Montmagny) and G district (north and south shores of Lac Saint-Pierre)	Done, in place since 1999
	Liberalise the daily bag limit (20 birds) and possession limit (60 birds)	Done, in place since 1999
	Legalise the use of electronic calls	Done, in place since 1999
	Legalise the use of stalking in spring and fall	Done, in place since 1999
	Legalise the use of baits in springtime and lure crops in the fall	Done, in place since 1999
	Inform the working group on waterfowl and wildlife on recommended actions	Done, in place since 1999
	Establish feeding grounds and maintain those of the RCM Montmagny that have been in place since spring 1997	Maintenance of feeding grounds in the RCM Montmagny , no new feeding grounds
	Review the whole scaring program	Done, new program in place since 1999
	Plan for compensation payments by the Financière agricole du Québec	Done, program pursued since 1997
Habitat management and farmland depredation	Support the adoption of soil and water conservation measures in the production of corn and cereal grain	Not done except in some places
	Promote the creation of farm ponds in the south-western area of Québec	Not done
	Explore fiscal measures to replace farmer compensations	Not done
	Refine methods for assessing impacts on agricultural production	Partly done
	Transform certain idle lands into grassland to increase areas used by the geese	Not done
Other	Better define the economic spin-offs generated by goose migration	Partly done
	Ensure a better monitoring of management measures and pursue the on-going scientific studies	Done, many on-going follow-ups, many new ones have been added
	Inform the public	Done, on-going basis

Plant productivity on the breeding grounds of the Greater Snow Goose in the Arctic has been relatively good since 1997. On the other hand, it would be difficult to distinguish between the effect of particularly favourable weather conditions during this period and the impact of the special management measures that allowed for the maintenance of the population. Additional knowledge is necessary in other newly or more intensively used areas in the Arctic since the population explosion. In addition, the natural habitats used by the geese on their migratory and wintering areas continue to be intensely visited, especially in some specific sites. However, the increasing use of farmland as alternative feeding areas and the inaccessibility of a portion of the bulrush rhizomes (*Scirpus pungens*), due to substrate hardness and root depth, appears to prevent, in a certain way, a more significant and irreversible degradation of these environments.

As for the actions relating to crop damage, the assessment mentions the maintenance of the crop damage financial compensation program implemented in 1992 and the maintenance of the 80% refund since 1999 for damages caused by the geese. As we know, crop damage results from the geese's intensive grazing in forage crops and sometimes from their feeding on cereal and corn seedlings in early spring, and more recently, on grain in the fall. The results tend to show that crop damages vary from year to year and that no precise trend seems to have been observed following the implementation of the special measures (Figure 3). The extent of crop depredation is not related to population size only, but also to other variables such as fall conditions during crop harvesting, to spring weather conditions, to flight distribution (flight dispersion and movement in the spring) and in some cases, to the management of crops. In general, the average annual loss in Québec has been around $750,000. It has been observed since 1999, except for 2002 which is considered by many as an exceptional year, that annual losses amount relatively close to the average or below.

In the past few years, a collective scaring program has also been planned and implemented as a spring preventive measure on the whole territory visited by the geese. Collective scaring is possible under section 24 of the Migratory Bird Regulations, which provides that any person holding a permit may disperse the birds that cause or risk causing crop damage. The Canadian Wildlife Service monitors the effectiveness of this program along with other implemented management measures. According to the first estimates, it seems that dispersing has proved to be an efficient and cost-effective measure since each dollar invested in prevention has reduced by three dollars the compensation amount for crop damage. Figure 3 presents the cost breakdown of the dispersion campaign. It has been observed that this cost has increased from year to year since the program was established due to increased geese dispersion.

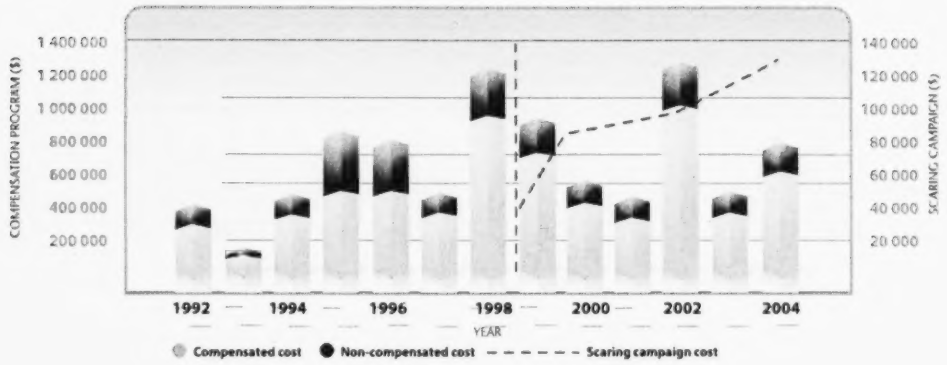

Figure 3: Costs related to the crop damage compensation program and dispersion program (1992-2004). The vertical dotted line indicates the start of the special conservation measures.

It should be noted that some of the actions planned in the 1997-2002 Action Plan were not given significant consideration due to a lack of time or lack of means available to implement them, as for example the adoption of fiscal measures to replace farmer compensations. Concerning the establishment of feeding grounds, it seems that this measure has generated little interest from the farming community due to its high cost, although the measure has proven to be interesting as a small scale land management tool, such as been demonstrated in the Côte-du-Sud (i.e. Montmagny and surroundings) region. Consequently, a small number of sizeable feeding grounds have been created elsewhere in the territory. Between 1997 and 2003, the total acreage used as feeding grounds has decreased (in the Montmagny RCM alone, it went from 540 ha/year to 120 ha/year) and as a result, it is difficult to accurately assess the actual potential of that intervention tool. In fact, it was not possible to conduct the scaring program in terms of the availability of such geese feeding and loafing areas.

The disturbance generated by the presence of hunters and scaring devices has an impact on geese distribution. On the one hand, the geese dispersed over a larger territory, they abandoned some traditionally used grounds to visit new areas such as the eastern tip of Ontario and the Lac Saint-Jean region. On the other hand and were present in smaller numbers or for a shorter period of time. Hunting and bird-watching opportunities seem to have been affected in some sectors such as Lac Saint-Pierre. On the positive side, the population dispersion over a larger territory has created opportunities for goose observation and hunting in new sectors such as the Victoriaville area or Lac Saint-Jean region.

Photo : André Lanouette

Other Actions (Scientific Monitoring)

The other actions identified in the 1997-2002 Action Plan dealt particularly with the acquisition of scientific knowledge and the sharing of this information with stakeholders and the general public. Most of the objectives have been achieved. In fact, during the entire previous action plan, stakeholders were able to share results and adjust the modalities and scope of some of the actions undertaken through the meetings of the Committee for the Integrated Management of Greater Snow Geese held in September of each year, and the published reports of these meetings. To this date, eight meetings have been held.

Most recommendations dealing with the need for population or habitat monitoring were maintained or implemented, making this population one of the most documented in Québec. For example, researchers from the Université du Québec à Montréal conducted studies using geese equipped with radio transmitters to develop a correction factor for population size evaluation. Their study showed that between 11% and 29% of all geese were missed during the spring surveys. After that, adjustments were made to the survey methodology because of the changes in geese distribution and migratory behaviour in southern Québec (see below). Researchers from the Centre d'études nordiques at Université Laval conducted an important monitoring program on the demography of the Greater Snow Goose breeding population on Bylot Island, located in the Canadian Arctic, and on the conditions of their habitat, thanks to funding from, among others, the Arctic Goose Joint Venture. An exhaustive review of the scientific literature indicates that more than 58 scholarly articles and technical reports have been published since 1997, which was the first year of the implementation of the previous action plan. A detailed list of scientific and technical publications on the Greater Snow Goose is presented at the end of this document.

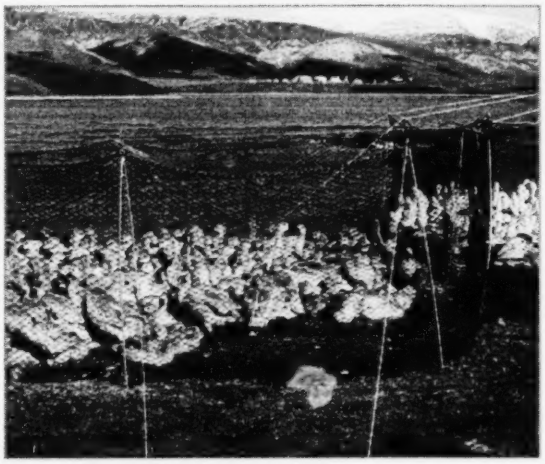

Photo : Gérald Picard, Université Laval

Finally, the Greater Snow Goose issue in Québec and the implementation of the action plan have been widely covered by the media, mainly during the first years, due in large part to the establishment of a spring conservation harvest. Thus, we can list over twenty articles on the Greater Snow Goose in the French general-interest print media since 1997.

Photo : Gérald Picard, Université Laval

A number of actions were undertaken in 2003 and 2004 in order to complete the implementation of the 1997-2002 Action Plan and to try and confirm certain observations and more recent trends. We deem it important to present them in a summarised fashion since these actions were very useful in guiding the development of the current action plan and may be used later as measures to evaluate the success of the action plan.

Impacts on the Natural Habitat

With the exception of the annual vegetation monitoring on Bylot Island, there are few results from new studies are available on the conditions of Arctic natural environments used by Greater Snow Geese for grazing. In fact, only a single study, undertaken in the Arctic region, has allowed us so far to estimate the carrying capacity of the Greater Snow Goose's natural habitats.

However, a five-year project was launched in 2004. Its purpose is to pursue and improve the on going studies on the conditions of the bulrush marshes of the St. Lawrence estuary, notably the long-term monitoring in the Cap Tourmente National Wildlife Area (NWA) in order to obtain data on the ecological integrity of the ecosystems used by the geese during their migratory stopovers. It is hoped that this study will serve to initiate an analysis of the impact of the loss of vegetation productivity (in the order of over 60%) and the changes in the specific composition of the vegetation on the biological cycle of other animal species that use these habitats as well as on the ecological functions of bulrush marshes in regards to the St. Lawrence River's primary productivity and food chain.

Data on the density of the bulrush stems, collected in 2004 as part of the long-term monitoring program undertaken in the Cap Tourmente National Wildlife Area, confirmed the decline observed since 1971. However, the stem density seems relatively stable since the early 1990s and also remained substantially the same since the implementation of special conservation measures in 1999 (Figure 4). Data collected on the St. Lawrence south shore at Montmagny and Cap Saint-Ignace confirmed this apparent stability since the 1990s; the data also confirmed that a steady-state condition of low productivity has been reached. Availability, energy cost for acquiring rhizomes and the increasing use of farmlands by the geese for feeding would explain this phenomenon.

We may then conclude that, since the first scientific assessment published in 1998, few changes seem to have occurred in the conditions of natural habitats used by the Greater Snow Goose and no additional degradation has been observed. However, it is difficult to determine if this situation is associated with the stabilisation of the population size, to the effect of possibly more favourable weather conditions in the past years (especially in the Arctic region) or to an increased use of farmland during the migration and wintering periods.

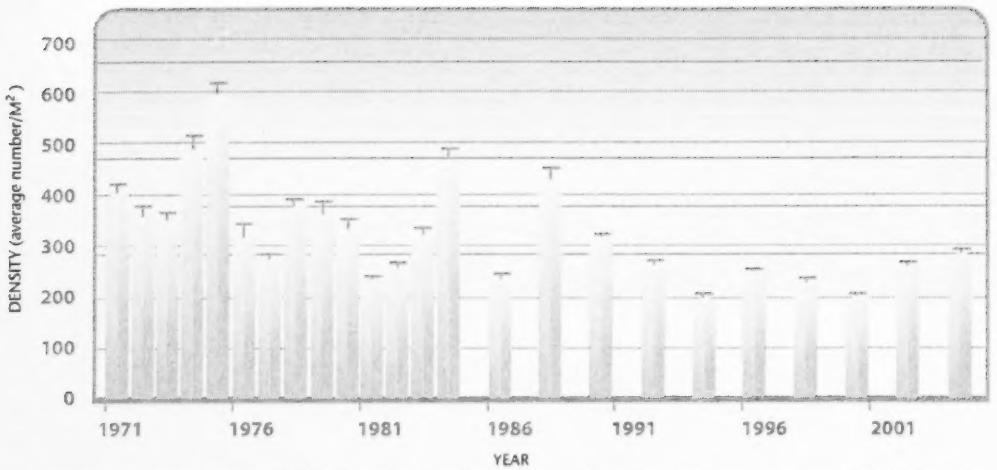

Figure 4: Average density of bulrush stems (average number/m2) in the Cap Tourmente National Wildlife Area, St. Lawrence River estuary (1971-2004).

Impacts on Farmlands

Preliminary analyses of farmer compensation data provided by the Financière agricole du Québec and considering only depredation by the Greater Snow Goose (i.e. excluding the Outaouais and Abitibi regions where the geese are absent) have shown that the number of affected farmers has not changed significantly from 1992 to 1998 (average: 363) and from 1999 to 2004 (average: 383 - Table 2); that is, before and after the implementation of special conservation measures. The total surface area of fields where damages by waterfowl were observed did not change significantly the same during the period without prevention programs (1992-1998) and during the period in which such a program was place (1999-2004; Table 2) and this, despite the important increase in the number of geese – which nearly doubled – for that same period. The total losses varied from $211,514 to $1,264,398 (average: $680,418) before 1999 and going up to between $511,540 and $1,312,124 after 1999 (average: $800,957). Even if the global amount seems to be higher, the analysis does not indicate any significant difference.

In all regions, forage crops are the most vulnerable to damage by waterfowl throughout the period in question (Table 3). Despite a seemingly downward trend, the surface area of forage crops with more than 75% damage as well as the number of farmers compensated has not decreased significantly following the implementation of the prevention program (scaring devices). Neither have we noticed any significant difference in the areas of forage crops affected more than 75% between the periods with and without a prevention program (Table 3). However, we can observe that damages to grain seedlings have been increasing since 1999 and that they affect a considerably larger number of farmers (Table 3). We did not observe any important differences in the number of hectares or of farmers affected following the application of prevention measures for grain corn fields and ensilage as well as for soy, canola and buckwheat crops.

To sum it up, after examining damages done to harvests without considering the type of crop,we observed two distinct phenomena:

1) a decrease in damages to the species' traditional migration areas;
2) an intensification of damages since 1999 in the regions only recently colonised by the Greater Snow Goose, such as Lac Saint-Jean (Figure 5).

Thus, for the Lower St. Lawrence region, the average would be 1617.4 ha from 1992 to 1998, and 628.3 ha from 1999 to 2004. For the Côte-du-Sud area, the average would be 1509.4 ha from 1992 to 1998, and 533.4 ha from 1999 to 2004. Therefore, we observe a 66% decrease in damages since 1999, i.e. after the establishment of the scaring program and spring conservation harvest.

Table 2: Total agricultural losses caused by waterfowl from 1992 to 2004 (Source: Financière agricole du Québec).

Year	Farmers* (n)	Area (ha)	Total losses ($)	Compensated losses ($)	Compensated losses (%)	Loss average/ha ($)
1992	301	3,309	466,589	373,271	80.0	141
1993	167	1,427	211,514	169,211	80.0	148
1994	396	4,188	534,891	399,970	74.8	128
1995	407	6,508	904,043	560,000	61.9	139
1996	375	4,884	844,213	560,000	66.3	173
1997	406	4,656	537,280	429,824	80.0	115
1998	487	7,457	1,264,398	1,000,000	79.1	170
Average	363	4 633	680 418	498 897	75.0	145
1999	543	4,977	978,513	782,810	80.0	197
2000	273	2,853	619,114	495,290	80.0	217
2001	208	2,101	511,540	409,232	80.0	243
2002	670	7,988	1 312,124	1,049,699	80.0	164
2003	233	2,550	547,425	437,940	80.0	215
2004	370	4,695	837,024	669,619	80.0	178
Average	383	4,184	800,957	640,785	80.0	202

**A farmer can be counted more than once if more than one of his crops has suffered damage.*

Table 3: Annual losses (number of farmers and surface area) for the different crops, 1992-2004. (Source: Financière agricole du Québec).

Year	Forage crop				Grain corn		Forage corn, soy, canola, buckwheat		Grain seedlings	
	Stratum 75% +		Stratum 10 to 74.9%							
	Farmers	Area (ha)	Farmers	Area (ha)	Farmers	Area (ha)	Farmers	Area (ha)	Farmers	Area (ha)
1992	120	1,354	177	1,914	0	0	0	0	4	41
1993	74	616	86	777	0	0	0	0	7	34
1994	147	1,609	246	2,556	0	0	0	0	3	23
1995	172	2,602	219	3,796	7	40	1	3	8	67
1996	131	2,027	234	2,790	0	0	0	0	10	67
1997	161	2,343	235	2,259	1	1	1	5	8	47
1998	298	2,609	95	3,382	80	1,382	3	9	11	75
Total (av.)	1,103 (157.6)	13,160 (1,880.0)	1,292 (184.6)	17,474 (2 496.3)	88 (12.6)	1,424 (203.4)	5 (0.7)	17 (2.4)	51 (7.3)	355 (50.7)
1999	130	1.387	290	2,431	83	847	19	147	21	165
2000	46	441	172	1,646	5	16	0	0	50	750
2001	49	459	110	1,183	17	117	1	4	31	338
2002	206	2.402	443	5,392	9	109	3	8	9	77
2003	48	467	103	1,403	1	7	2	8	79	665
2004	111	1,315	234	3.225	8	32	1	6	16	117
Total (av.)	590 (98.3)	6,471 (1,078.5)	1,352 (225.3)	15,280 (2,546.7)	123 (20.5)	1.128 (187.9)	26 (5.2)	173 (34.5)	206 (34.3)	2,112 (352.1)

Stratum 75% +: farmlands with a grazing density estimated at 75% and over.
Stratum 10-74.9%: farmlands with a grazing intensity estimated at 10 to 74.9%.

Table 2: Total agricultural losses caused by waterfowl from 1992 to 2004 (Source: Financière agricole du Québec).

1992	301	3,309	466,589	373,271	80.0	141
1993	167	1,427	211,514	169,211	80.0	148
1994	396	4,188	534,891	399,970	74.8	128
1995	407	6,508	904,043	560,000	61.9	139
1996	375	4,884	844,213	560,000	66.3	173
1997	406	4,656	537,280	429,824	80.0	115
1998	487	7,457	1,264,398	1,000,000	79.1	170
1999	543	4,977	978,513	782,810	80.0	197
2000	273	2,853	619,114	495,290	80.0	217
2001	208	2,101	511,540	409,232	80.0	243
2002	670	7,988	1 312,124	1,049,699	80.0	164
2003	233	2,550	547,425	437,940	80.0	215
2004	370	4,695	837,024	669,619	80.0	178

**A farmer can be counted more than once if more than one of his crops has suffered damage.*

Table 3: Annual losses (number of farmers and surface area) for the different crops, 1992-2004. (Source: Financière agricole du Québec).

1992	120	1,354	177	1,914	0	0	0	0	4	41
1993	74	616	86	777	0	0	0	0	7	34
1994	147	1,609	246	2,556	0	0	0	0	3	23
1995	172	2,602	219	3,796	7	40	1	3	8	67
1996	131	2,027	234	2,790	0	0	0	0	10	67
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Total (av.)	1,103 (157.6)	13,160 (1,880.0)	1,292 (184.6)	17,474 (2 496.3)	88 (12.6)	1,424 (203.4)	5 (0.7)	17 (2.4)	51 (7.3)	355 (50.7)
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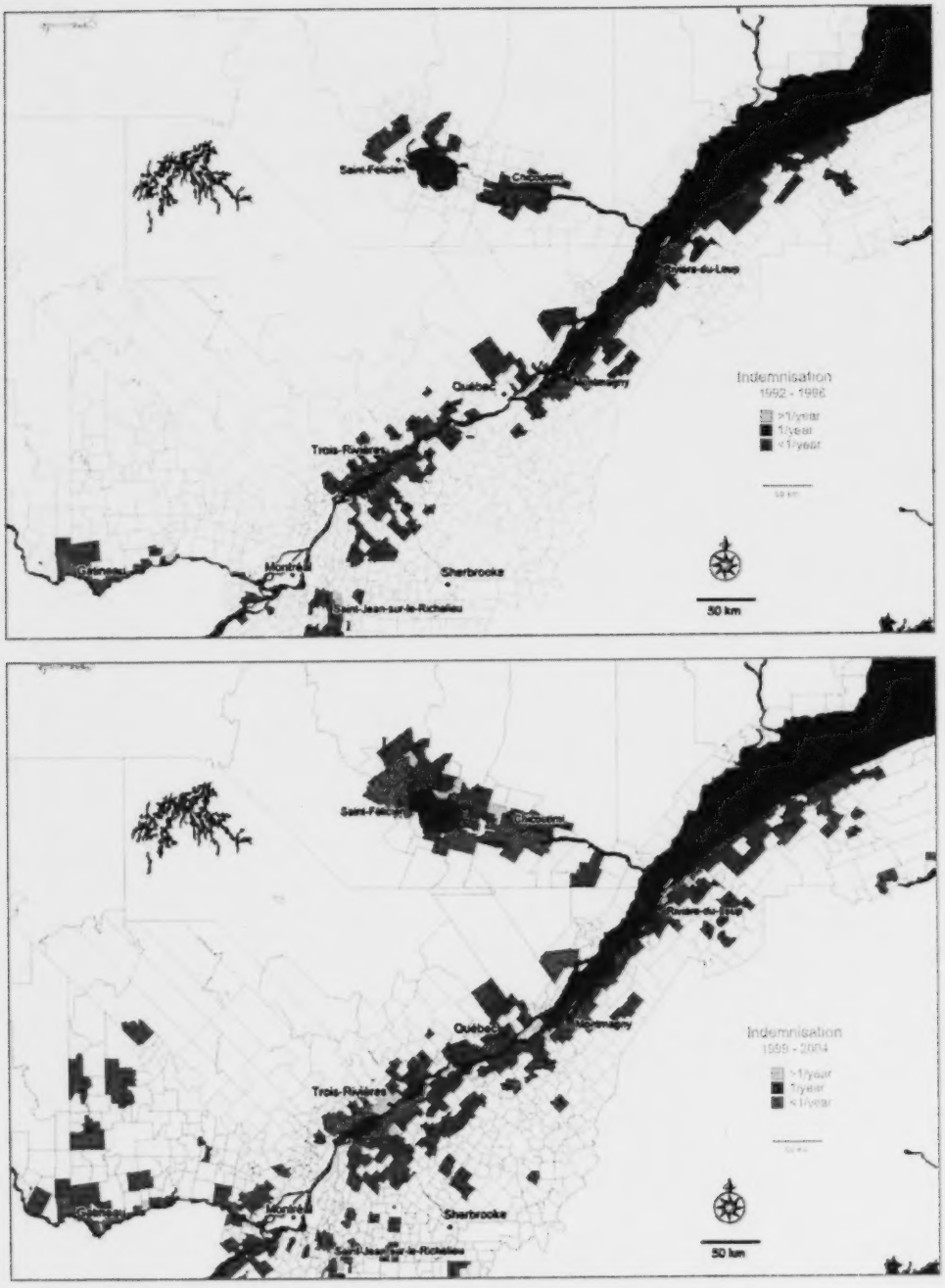

Figure 5: Territorial distribution per municipality of waterfowl crop damage compensation in Québec before and during the prevention program.

The budget spent on spring goose scaring in cultivated fields has been constantly increasing since the beginning of the program, notably because new regions were added to the territory to be covered over the years. Expenses related to these activities reached $107,866 in 2003 and $126,400 in 2004, compared to $94,100 in 2002. As in the past, the Côte-du-Sud area shows the highest cost for this activity. More attention should be given to both data collection and data analysis in the coming years in order to maximise the program's outcome.

Evaluation of Socio-economic Benefits

The phenomenal population increase over the last decades generated a significant increase in hunting opportunities, bird watching and ecotourism (festivals, interpretation centres, etc.) associated with the presence of the Greater Snow Goose. This generated increasing economic spin-off for many localities in Québec. A recent study on the socio-economic impacts of the migratory stopovers of the Greater Snow Goose and the Canada Goose in Québec indicates a direct and indirect spin-off of approximately 31 million dollars associated with activities such as hunting, bird-watching, and ecotourism (with 16.4 million dollars in direct spin-offs) and a cost estimated of approximately 1.6 million dollars in scientific research and monitoring expenditures as well as in compensation costs and crop damage prevention (Table 4).

Table 4: Yearly evaluation of economic impacts attributable to the Greater Snow Goose and Canada Goose migrating in southern Québec.

	Direct impact	Indirect impact			Spill-over impact	Total impact
		Primary suppliers	Other suppliers	Subtotal		
Hunting						
Trips under 24 hours	$ 353,415	$ 47,405	$ 28,155	$ 75,561	$ 171,590	$ 600,565
Trips over 24 hours	$ 1,129,276	$ 214,080	$ 129,354	$ 343,435	$ 589,084	$ 2,061,795
Purchase of equipment	$ 2,009,808	$ 469,073	$ 160,828	$ 629,901	$ 1,055,884	$ 3,695,593
Subtotal	**$ 3,492,499**	**$ 730,558**	**$ 318,338**	**$ 1,048,896**	**$ 1,816,558**	**$ 6,357,954**
Bird watching						
Trip and accommodation	$ 5,951,738	$ 1,429,767	$ 747,857	$ 2,177,624	$ 3,251,745	$ 11,381,107
Purchase of equipment	$ 4,164,138	$ 971,875	$ 333,222	$ 1,305,097	$ 2,187,694	$ 7,656,929
Subtotal	**$ 10,115,877**	**$ 2,401,642**	**$ 1,081,078**	**$ 3,482,721**	**$ 5,439,439**	**$ 19,038,036**
Other						
Festivals/interpretation centres	$ 2,301,726	$ 544,503	$ 319,932	$ 864,435	$ 1,266,465	$ 4,432,626
Organisations' operations	$ 581,000	$ 138,658	$ 47,541	$ 186,199	$ 306,880	$ 1,074,079
TOTAL	$ 16,491,102	$ 3,815,362	$ 1,766,889	$ 5,582,251	$ 8,829,341	$ 30 902 694

Financial evaluation - average of damages (1)	$ 750,000
Cost of scaring activities (2)	$ 100,000
Budget allocated by Canadian Wildlife Service and university partners to the management and study of the Greater Snow Goose and Canada Goose populations (3)	$ 710,000
TOTAL	$ 1,560,000

(1) Annual average of damages evaluated for the 2000-2004 period.
(2) Annual average cost of scaring activities from 2001 to 2003.
(3) Annual average from 1997 to 2003.

The study shows that bird watching activities generate the highest economic benefits, i.e. over 19 million dollars annually (10 million of which are in direct benefits), which represents 62% of the total amount (Table 4). This amount refers only to bird-watching activities in the four main locations of Québec: Montmagny sector, Baie-du-Febvre on Lac Saint-Pierre's south shore, Cap Tourmente National Wildlife Area and Parc provincial de Plaisance in Outaouais. As for hunting, it generates over 6 million dollars per year (3.5 million dollars in direct expenses), or 21% of the total amount. Festivals and interpretation centres generated over 5 million dollars (3 million dollars in direct expenses); this corresponds to 18% of the total benefits (Table 4). In this case, the main events considered are the Greater Snow Goose Festival in Montmagny, the Greater Snow Goose Festival in Saint-Joachim and the Canada Goose Festival in Saint-Fulgence. The educational facilities considered in the study are the interpretation centres associated with the main areas visited by the geese, in addition to the Centre d'interprétation des battures in St. Fulgence. It should be noted that for both costs and benefits, it is difficult to consider all possible factors. So it is necessary to consider the evaluation as minimal.

To calculate the economic benefits according to the cross-sectoral model developed by the Institut de la statistique du Québec, the study takes into consideration the purchase of activity-related equipment, the expenditures incurred for hunting trips (under 24 hours) or accommodation (over 24 hours) as well as the operating expenditures of the organisations managing the activities. In the case of hunting, the costs for equipment purchases produce more benefits than travel, accommodation and food expenses combined with each amounting to 3.7 and 2.7 million dollars, respectively. The opposite, however, is the case for bird watching activities, with equipment purchases amounting to 7.7 million dollars while travel accommodation, and food expenses amounting to 11.4 million dollars (Table 4).

As for the cost of 1.6 million dollars attributable to goose migration, the annual average breakdown is as follows: $750,000 per year in crop damage (calculation based on the evaluation done by the Financière agricole du Québec), 80% of which are compensated; $ 100,000 in scaring activities (figures provided by the UPA); and $710,000 in study and management expenditures divided between all participating organisations (Table 4).

Estimate of the Spring Flock Size and Continental Target Population

Contrary to the majority of other waterfowl species whose population count is conducted on breeding and wintering grounds, the Greater Snow Goose survey has been conducted annually since 1965, in April or May, while the entire population is found in high concentrations on their spring migratory staging grounds in Québec. Due to the goose population explosion and changes in their migratory behaviour, many methodological adjustments have been made throughout the years. Thus, from 1965 to the end of the 1980s, all flocks of geese were photographed and every goose in the pictures counted. In the early 1990s, in order to reduce the processing time and survey-related costs, the size of all goose flocks were visually estimated, but only a sample were counted according to standard sampling procedures. Then, in response to the expansion of the goose distribution area, the methodology was changed in 2001 and again in 2004, following the results and recommendations from various studies on-going at the time. This last modification was meant to increase territory coverage through the use of a larger number of airplanes in synchrony.

Despite the improvements brought to the methodology for the spring survey of the Greater Snow Goose continental population, it is important to note that this is an estimation of the photographed population and not a census of the total goose population, and that the proportion of flocks photographed is not known. A study to evaluate the feasibility of an annual monitoring program of geese fitted with satellite transmitters was initiated in 2005 with the assistance of university partners. Besides allowing us to estimate the number of geese missed by the surveys, such a project also allows us to better identify the geese's migratory routes as well as their distribution at different times of the year. Following the Greater Snow Goose population explosion, the use of new nesting habitats is poorly known in the Arctic breeding areas. A method for counting flocks of geese using digital photography and specialised software is also being developed, which might allow us to control the variability of the annual count of the goose population during the spring survey.

A very accurate estimate of population size is useful in terms of management once a target value has been determined. In the last update of the North American Waterfowl Management Plan in 2004, this target population was established by American and Canadian wildlife agencies at 500,000 geese. The group of experts who participated in the recent assessment of this population recommends that in the coming years, a target size be determined based on ecological and social considerations (Reed and Calvert, in progress). This approach would include elements such as:

1) continental population size;
2) carrying capacity of natural habitats;
3) potential of hunting regulations as a tool for short-term population control;
4) value or importance of socio-economic benefits associated with the presence of geese in their breeding, migratory and wintering areas.

Hunting as a Population Control Tool

The spring conservation harvest, as implemented in Québec in 1999, is an exceptional measure for waterfowl management. A modelling of the spring and fall hunt's impact in Québec and the United States, based on data collected between 1965 and 2003, shows the anticipated effect of various hunting scenarios in the coming years (Figure 6). According to the model, only the scenarios including the spring conservation harvest (C, D and E) would allow to control the population size.

The other two scenarios (A and B) predict a population increase if we exclude this special measure that would have to be counterbalanced by a 69% increase in total adult harvest if applied in Québec only, and by 36% and 37% respectively if applied simultaneously in Québec and the United States.

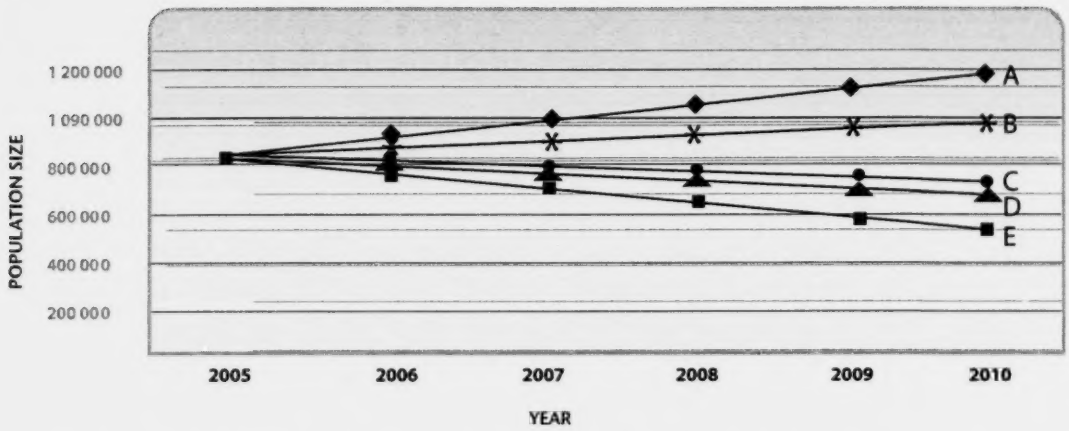

Figure 6: Modelling of the impact of various scenarios for Greater Snow Goose management over the next five years. Scenario A: No conservation measures (situation between 1985-1998); Scenario B: Without a spring harvest but with special measures maintained during the regular season; Scenario C: With a spring harvest in alternating years and reduction in fecundity; Scenario D: With a spring harvest but no reduction in fecundity; Scenario E: Situation between 1999-2003 with the implementation of special measures (Reed and Calvert, in progress).

Thus, the predictive model for population trend elaborated as part of the second scientific assessment and incorporating different breeding parameters and the harvest rate observed in the past few years allows us to predict that if we maintain the special measures currently applied in Québec as well as those applied in the United States, the Greater Snow Goose population would be above the objective of the recent update of the North American Waterfowl Management Plan (i.e. 500,000 individuals). However, many factors may affect the model's performance and modify the impact of these special measures over the next five years, so it is reasonable to believe that the population should be between 500,000 and 750,000 individuals by 2010.

For example, data for the last three years tend to demonstrate a certain decrease in the efficiency of population control based primarily on the spring conservation harvest in Québec. Indeed, the data from the spring harvest survey show that most hunters practice their activity on weekends and only a few times during the year. This decreases the impact of scaring on weekdays as well as the hunting potential (two days of hunting out of seven). Over the years, a decline in both hunting activities and total number of geese killed has also been observed (Figure 7). It should be mentioned that this type of hunting is increasingly difficult due to the suspicion of adult and sub-adult geese and to the splitting up of flocks into smaller flocks scattered over a larger territory as a result of disturbances generated by hunters and scaring devices.

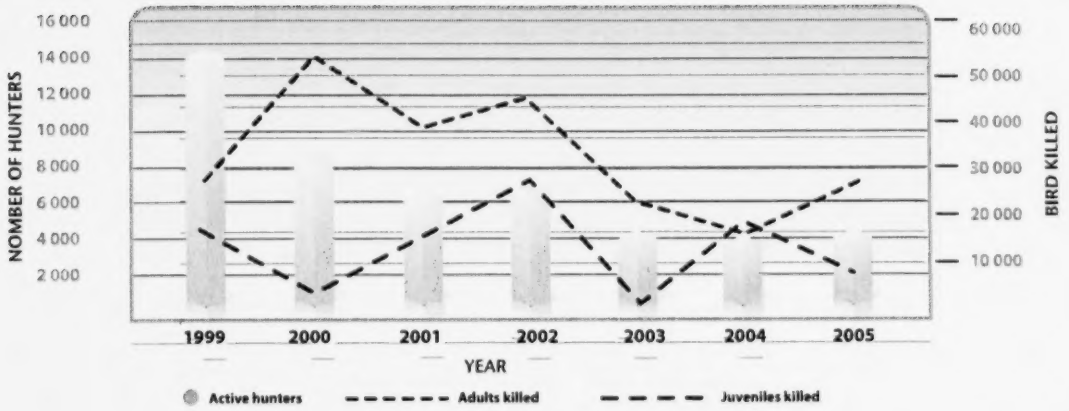

Figure 7: Participation of hunters and harvest levels during the spring conservation harvest from 1999 to 2005 in Québec.

Moreover, it seems evident that the environmental conditions that have led to the species overabundance are still present, if not increasing in the eastern area of the continent. These conditions include milder breeding seasons in the Arctic and an increase in the total area of corn crops and other grains grazed by Greater Snow Geese on their migratory and wintering areas. Such environmental conditions are therefore likely to foster a better physical condition of breeders and a decrease in natural deaths throughout their life cycle.

Thus, a decrease in the spring conservation harvest in Québec combined with conditions likely to foster a higher survival and reproductive rate of individuals has led the experts who took part in the second scientific assessment to recommend an increase in the United States winter hunt as the only long-lasting solution to control the Greater Snow Goose population in North America. As well, from a sustainable development perspective, it seems urgent to establish a conservation strategy that allows for the integration of both harvest and habitat management over the bird population's entire vital area. That would allow us also to better focus the species management plans on actions to be implemented at more regional levels (regulatory adjustments, integrated habitat management, land-use planning, cohabitation of bird watching and hunting activities, etc.). However, still according to the recommendations of the group of experts involved in the first scientific assessment, a population of over 1,000,000 individuals risks generating many adverse ecological consequences. Furthermore, controlling a population of that size would become very difficult, if not impossible, without reverting to excessively severe methods of intervention, usually negatively perceived by the public.

Among all the recommendations formulated in 1998, the one on habitat management could not be acted upon in the past years, not only in terms of as a management tool for goose hunting or watching opportunities, but also with regards to damage prevention of natural habitats and crops (feeding grounds). Therefore, it now seems that only a more rigorous management based on the use of the territory by the geese themselves would rally regional stakeholders around the same vision and around an implementation plan adapted to the particularities of their region. Such a management plan should consider, for example, the

geese's particular land-use pattern, the type of agriculture being practised, hunters' habits, bird watchers' preferred locations, etc.

Engaging local stakeholders in a proactive dialogue would allow to rally those who benefit from the presence of the geese (suppliers, hotel-keepers, restaurant owners, festival organisers, interpretation centres, and ornithological clubs) and those who suffer financial consequences, mostly farmers. This would finally allow us to invite to the discussion table new stakeholders and organisations responsible for the socio-economic planning of the territory.

Photo : Cédric Juillet

Photo : André Lanouette

The second scientific assessment prepared as part of the Arctic Goose Joint Venture (Calvert and Reed, in progress) as well as the results of different studies conducted from 2003 to 2005 indicate that:

- the special conservation measures implemented between 1999 and 2003 have allowed to stop the population growth and stabilise it between 800, 000 and 1,000,000 individuals. Among all these measures, the spring conservation harvest and, to a lesser extent, the liberalisation of hunting regulations for spring season in the United States have shown to be the most efficient ones;
- few changes seem to have occurred in the conditions of natural habitats used by the Greater Snow Goose and no further degradation has been observed both in Arctic environments and in the natural marshes used in Québec and the United States during the migratory and wintering period;
- the number of farmers whose crops have been affected by the geese in Québec has not increased significantly after the implementation of special conservation measures and the total acreage where waterfowl damages have occurred has remained substantially the same for forage crops, but has increased for grains. On the other hand, we have noted a decrease in damages done to traditional geese migration areas, while an intensification has been observed in the new sectors they now visit;
- scaring devices as a prevention measure against crop damage has shown to be an efficient and cost-effective management measure and generates potential savings in compensation costs. Further analysis should be undertaken to better understand and assess the benefits of the prevention program in the different regions of Québec;
- a study of the socio-economic impacts of migratory stopovers of the Greater Snow Goose and Canada Goose in Québec revealed that the direct and indirect benefits amounting to at least 31 million dollars are associated with hunting, bird watching and ecotourism activities. The cost of studies and geese monitoring, farmers compensation and crop damage prevention is estimated at 1.6 million dollars;
- disturbance generated by the presence of hunters and scaring devices in spring appears to cause the geese to disperse over a larger territory, to abandon the use of some traditional sites to use new ones. Consequently, that seems to have hindered the hunting and bird watching opportunities in some sectors although it has allowed for such activities in sectors that were rarely or not visited by the geese in the past.

Based on these findings, the Canadian Wildlife Service wishes to implement a specific operational framework for integrated and sustainable management through the development and implementation of the 2005-2010 Action Plan with its partners of the Committee for the Integrated Management of Greater Snow Geese in Québec. In the coming years, this process will focus on achieving a global and common vision of the international resource that the Greater Snow Goose represents, achieving the continental population objective, and developing and implementing an integrated strategy for habitat and harvest management.

Therefore, the 2005-2010 Action plan includes the following objectives:

- to contribute to an international strategy for harvest management in the long term to reach the objective of the North American Waterfowl Management Plan (500,000 geese), and to determine a target population based on ecological and socio-economic considerations;

- to prevent, through habitat management, further degradation of bulrush marshes and increased crop damages while improving goose hunting and watching opportunities on the most important migratory staging areas, which will allow us to preserve the socio-economic benefits generated by the geese.

Strategies

In consultation with our partners of the Committee for the Integrated Management of Greater Snow Geese, the Canadian Wildlife Service intends to implement several strategies. The purpose of these strategies will be to promote an integrated and sustainable management of this resource by intervening at different planning and implementation levels addressing both population size and distribution consistent with the following principles:

- basing its management decisions on the best scientific and technical information available. To this end, maintaining in the long-term and in an efficient manner the existing biological and socio-economic monitoring mechanisms in order to regularly assess and review the management measures implemented in Québec and elsewhere;
- adopting an implementation approach consistent with the geese's specific land-use needs in order to promote a proactive dialogue and the participation of all regional stakeholders in the sharing of costs and benefits associated with the presence of geese;
- maintaining the existing coordination processes that allow to disseminate information on the Greater Snow Goose issue in the main national and international forums, and fostering partnerships and communication between Québec's stakeholders and the general public.

In the 2005-2010 Action Plan, orientations and strategic actions are broken down into 10 sections:

1. Ensure the long-term maintenance of a quality spring survey of the continental population:

1.1. by maximising the territory covered by the spring survey in order to take into account the use of new sectors by the geese;
1.2. by making a reconnaissance effort on the days preceding the survey and by using the information available from geese scarers and ornithologists on the geese distribution as a source of information at the regional level;
1.3. by elaborating a correction factor (annual proportion of the total flock surveyed) in order to obtain a non-biased annual estimate of the continental population;
1.4. by developing a technique that allows a computerised count from digital photographs of geese and which minimise errors during the different operations.

2. Undertake scientific studies to ensure the monitoring of the population's reactions to management interventions:

2.1. by maintaining the annual monitoring of reproduction on Bylot Island and by exploring the possibility of including new monitoring sites in the Arctic;
2.2. by continuing the goose banding program on Bylot Island and the identification of banded individuals in southern Québec in spring and fall in order to ensure the monitoring of management measures on population demographics;
2.3. by continuing the juvenile/adult ratio survey in southern Québec to measure the population's annual productivity on a long-term basis;
2.4. by analysing the available data in order to better understand, from a historical point of view, the evolution of geese dispersion in the different regions of Québec in response to agricultural changes and to past management measures;
2.5. by establishing, in the more frequently visited sectors, a detailed monitoring of the geese's land-use in partnership with local stakeholders (hunters associations, ornithological clubs, conservation groups, etc.);
2.6. by contributing to the improvement of predictive models of population trends in response to different management scenarios.

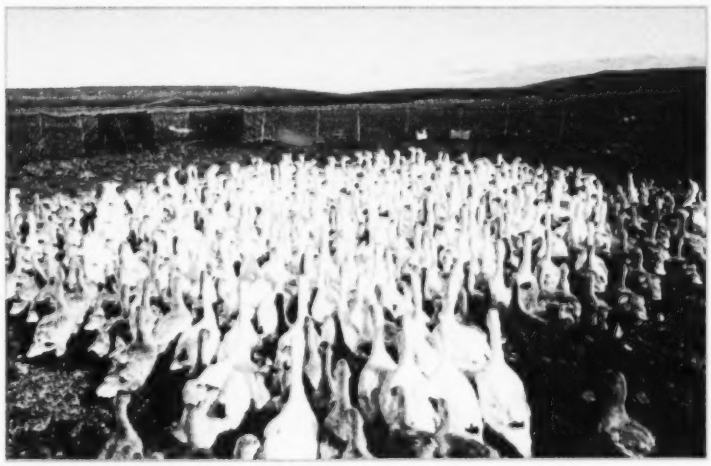

Photo : Gérald Picard, Université Laval

3. Maintain the total annual number of geese killed in Québec at the level of the past few years:

3.1. by maintaining sport hunting liberalisation effort initiated in 1998 (daily bag limit of 20 birds and annual limit of 60 birds);

3.2. by exploring the introduction of new measures and means likely to increase the total number of adult geese killed in the fall in Québec;

3.3. by maintaining, in the absence of a significant increase in the total number of geese killed by sport hunters, a spring conservation harvest limited to farmlands as an exceptional management measure until the target population set by the North American Waterfowl Management Plan is reached;

3.4. by allowing Greater Snow Goose hunting during the resident Canada Goose early hunting season;

3.5. by reviewing the protection status or the current limits of certain sites designated for the protection of the Greater Snow Goose while taking into consideration the protection of other species present in the area, notably endangered species.

4. Heighten United States authorities' awareness to the need of increasing harvest as a sustainable solution to control the continental population:

4.1. by ensuring the dissemination of the second scientific assessment conducted as part of the Arctic Goose Joint Venture;

4.2. by informing the concerned government authorities on the importance of implementing special measures in the United States to extend the hunting season;

4.3. by contributing to a review of the Greater Snow Goose target population under the North American Waterfowl Management Plan based on ecological and socio-economic considerations.

5. Maintain quality breeding and migratory habitats allowing to accommodate the largest possible number of geese in fall and spring:

5.1. by continuing to monitor the condition of the goose breeding habitats on Bylot Island, by refining the environment's carrying capacity measurement, and by exploring the possibility of including new monitoring sites in the Arctic;

5.2. by documenting the state of degradation of bulrush marshes traditionally used by the geese migrating through Québec, by acquiring more specific knowledge on their carrying capacity and by implementing a long-term program to monitor their ecological integrity;

5.3. by developing rehabilitation strategies for bulrush marshes, notably:

5.3.1. by developing hunting plans for periodical rotation of sectors with and without hunting in the main marshes;

5.3.2. by developing lure fall crops on adjacent public lands in order to minimise the impact of goose grazing in marshes so that they may have a higher carrying capacity the following spring.

6. Maximise bird watching and hunting opportunities by fostering the presence of important geese flocks on certain sites:

6.1. by reviewing the limits of certain no-hunting zones in order to maximise geese stopover time and preserve the quality of the show offered by the geese;

6.2. by postponing for a few days the opening dates of spring conservation harvests on some specific sites to maintain large flights for a given period for observation activities;

6.3. by changing existing agricultural practices through the establishment of a lure crop program to create corridors that might increase bird watching and hunting success.

7. Review the implementation of the crop damage prevention program to better target its effects:

7.1. by disseminating information on the impact of the geese according to their migration chronology and the main crops' growth phenology in sectors with a high risk of degradation;

7.2. by promoting to farmers the importance of implementing voluntary (scare canons, scarecrows, etc.) and guided (scaring devices) measures in order to maximise crop protection;

7.3. by concentrating the scaring efforts mainly on forage crops where over 90% of damages occur;

7.4. by reviewing the current feeding area program and by working at implementing a lure crop program on public lands in order to reduce damage to private lands;

7.5. by improving the collection of data and information by scaring devices to facilitate statistical processing of this information and maximise the benefits of the prevention program;

7.6. by continuing and improving the prevention program (goose scaring devices) taking into account its contribution in reducing the cost of crop damage compensation.

8. Enhance the crop damage compensation program and offer alternatives to farmers who suffer from important and recurrent losses from year to year:

8.1. by producing a detailed description of crop damage by the geese since 1992, and by accurately identifying the risk sectors, the most affected zones or sectors, year after year;

8.2. by identifying different fiscal options or other measures (sale or donation to a wildlife organisation, etc.) that may be offered to farmers at risk of important and recurrent damages;

8.3. by maintaining and promoting the waterfowl plan, and by documenting the mechanisms implemented in the United States in regards to crop damage by the Greater Snow Goose.

9. Pursue the undertaken cost/benefit approach for a more active and effective involvement of all public and private stakeholders, including those with a socio-economic mission:

9.1. by promoting the concerted action model developed throughout the years in the Côte-du-Sud area through the organisation of regional workshops on the Greater Snow Goose as the pillar of regional sustainable development;

9.2. by conducting a more detailed socio-economic study on certain important migratory stopovers;

9.3. by developing a regional implementation plan for the current action plan on the Greater Snow Goose for the Québec/upper estuary, Lac Saint-Pierre and Lac Saint-Jean sectors, and by involving wildlife, agricultural and socio-economic private and government stakeholders in the implementation.

10. Communicate the scientific principles and results of the proposed actions to partners, stakeholders and general public:

10.1. by continuing to hold meetings of the Committee for the Integrated Management of Greater Snow Geese (publication of an annual report on on-going activities and results), and by reporting to the members of the Migratory Bird Management round Table;

10.2. by disseminating the results of scientific studies on the Greater Snow Goose and by facilitating consultation of published documents;

10.3. by publishing general information pamphlets and presenting at public conferences on the different aspects of the Greater Snow Goose issue in Québec.

The implementation of the present plan over the upcoming years represents a real challenge and its success depends on many factors, including the participation of all stakeholders (notably the Committee for the Integrated Management of Greater Snow Geese in Québec) within the scope of their mandates, areas of expertise, fields of interest, as well as their access to the necessary funding to proceed with the implementation of the various targeted actions.

The Canadian Wildlife Service will coordinate the different activities relating to the management of the Greater Snow Goose population. Scientific monitoring of the goose population, their natural habitats, as well as the scientific evaluation of compensation and prevention programs, constitute the essential elements for the management of the Greater Snow Goose in North America. This is why, in collaboration with its partners, the Canadian Wildlife Service will take part in the evaluation of the special management measures that will be implemented over the coming years for this bird population which is still considered to be overabundant.

We wish to invite all partners of the Committee for the Integrated Management of Greater Snow Geese in Québec and other environmental stakeholders to take an active part in the implementation of the action plan in order to ensure the sustainable development of this important resource that is the Greater Snow Goose and make it an integrated management success story.

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